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ORIGINAL ARTICLE

# Suicidal Ideation, Mental Health Problems, and Social Impairment Are Increased in Adolescents with Acne: A Population-Based Study

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We performed a cross-sectional, questionnaire-based study to explore the relationship of suicidal ideation, mental health problems, and social functioning to acne severity among adolescents aged 18–19 years. A total of 4,744 youth were invited and 3,775 (80%) participated. In all, 14% reported having substantial acne (a lot and very much). Among those with very much acne, as compared those with no/little acne, suicidal ideation was twice as frequently reported among girls (25.5 vs. 11.9%) and three times more frequently reported among boys (22.6 vs. 6.3%). Suicidal ideation remained significantly associated with substantial acne (odds ratio 1.80, 95% confidence interval 1.30–2.50) in a multivariate model including adjustments of symptoms of depression, ethnicity, and family income. Mental health problems, as assessed by the Strengths and Difficulties Questionnaire (2.25, 1.69–3.00), low attachment to friends (1.52, 1.21–1.91), not thriving at school (1.41, 1.12–1.78), never having had a romantic relationship (1.35, 1.05–1.70), and never having had sexual intercourse (1.51, 1.21–1.89) were all associated with substantial acne in a multivariate model. Acne is frequently found in late adolescence and is associated with social and psychological problems. Adverse events including suicidal ideation and depression that have been associated with therapies for acne may reflect the burden of substantial acne rather than the effects of medication.

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## INTRODUCTION

Acne is a common, chronic skin condition that affects nearly all adolescents to varying degrees (Burton *et al.*, 1971; Gollnick *et al.*, 2008). About 10–20% of teenagers will have moderate to severe acne (Burton *et al.*, 1971; Kilkenny *et al.*, 1998; Smithard *et al.*, 2001; Purvis *et al.*, 2006; Halvorsen *et al.*, 2009). Knowledge of the psychosocial problems related to acne is of importance in determining optimal health care.

An association between isotretinoin therapy and increased risk of depression, suicidal ideation, and suicide has been claimed, but the current literature is conflicting and results from controlled studies are lacking (Jick *et al.*, 2000; Wysowski *et al.*, 2001; Hersom *et al.*, 2003; Marqueling and Zane, 2005; Strahan and Raimer, 2006; Azoulay *et al.*, 2008). In the controversy regarding possible side effects of isotretinoin, it is important to consider the possible increase in the risk of psychological problems that might be associated with having severe acne. A few large studies have shown frequent depressive symptoms in adolescents with acne (Kilkenny *et al.*, 1997; Purvis *et al.*, 2006; Halvorsen *et al.*, 2009). However, population-based studies comparing the frequency of suicide and suicidal ideation in teenagers with and without acne are scarce.

Suicidal ideation is an unpleasant symptom and indicator of emotional distress. Suicidal ideations—any self-reported thoughts of engaging in suicide-related behavior—are associated with suicidal plans and attempts (O'Carroll *et al.*, 1996; Wichstrom, 2000). An earlier attempt of suicide is the single most potent risk factor for youth suicide (Bridge *et al.*, 2006). In most industrialized countries, suicide ranks after injuries as the second leading cause of death among adolescents, and worldwide suicide rates are rising among young people (Blum and Nelson-Mmari, 2004).

In adolescence, the individual usually becomes increasingly autonomous. The relationship with family members changes, peer and romantic relationships become more important, and enduring relationships may begin (Neinstein, 2002). Psychiatric disorders increase in prevalence during adolescence (Neinstein, 2002; Costello *et al.*, 2003). Social relations affect physical and mental health and visa versa (Berkman *et al.*, 2000). Social isolation and insecure

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*Abbreviations: CI, confidence interval; OR, odds ratio; SDQ, Strengths and Difficulties Questionnaire*

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attachments have been linked to suicidal ideation (de Jong, 1992; Ledgerwood, 1999). The appearance of the skin is important in social interaction and for self-image (Dalgard *et al.*, 2008). Acne is the most frequent visible skin disease in adolescents. This makes it relevant to study the relations between acne, social functioning, and suicidal ideation.

This study aims to examine the associations of acne with suicidal ideation, mental health problems, and social functioning in a large representative community sample. We also wanted to explore whether a possible relationship between acne and suicidal ideation might be influenced by social functioning.

## RESULTS

A total of 4,744 adolescents mainly aged 18–19 years were invited to participate, and the overall response rate was 80% ($N = 3,775$). The sample characteristics are shown in Table 1.

The prevalence of a lot and very much (substantial) acne was 13.5% ($n = 493$), with a 95% confidence interval (CI) of 12.4–14.6%. The prevalence in boys was 14.4% (95% CI 12.7–16.1%) and 12.8% (95% CI 11.4–14.3%) in girls.

The prevalence of suicidal ideation was 10.9% (95% CI 9.9–11.9%) (Table 2). Suicidal ideation was noted significantly more often by those with increasingly severe acne (*P*-value for trend $<0.01$). Those with substantial acne were significantly more likely to report suicidal ideation than those with less acne: crude odds ratio (OR) 2.38 (95% CI 1.79–3.16) and an adjusted OR of 1.80 (95% CI 1.30–2.50). These associations were also statistically significant in analyses stratified by gender (Table 3).

Those with substantial acne were significantly more likely to report mental health problems measured by the Strengths and Difficulties Questionnaire (SDQ) than those with less acne, with adjusted OR 2.25 (95% CI 1.69–3.00) also significant in both genders (Table 3).

Social impairment was more common with increasing acne in the six variables (*P*-value for trend $<0.01$) (Table 4). Adjusted bivariate analyses (Table 5) demonstrate that adolescents with substantial acne reported lower attachment to friends and were not thriving at school. They also reported less experience with romantic relationships and sexual intercourse compared with those with no/a little acne. When stratified by gender, we found that in boys, low attachment to family, low attachment to friends, and never having had sexual intercourse were associated with substantial acne. In girls, not thriving at school was associated with substantial acne.

Six different forms of social functioning were separately introduced in the adjusted multivariate model for the association between acne and suicidal ideation (Table 6). No important changes in ORs were demonstrated in these six analyses compared with the adjusted OR of 1.80 between acne and suicidal ideation.

## DISCUSSION

Nearly 15% of 18- and 19-year-old adolescents in Oslo, Norway reported having a lot and very much acne, which corresponds to substantial acne, and by dermatologists consider would ''benefit from medical therapy'' (Halvorsen *et al.*, 2008). The prevalence of acne that we observed is comparable to that seen in other population-based studies (Kilkenny *et al.*, 1998; Smithard *et al.*, 2001; Purvis *et al.*, 2006). Acne is a well-known condition and easy to self-diagnose. In this age group, other conditions with a similar appearance are rare. As adolescents were asked about their acne problems in the previous week (that is, active acne), our prevalence probably underestimates the proportion of 18- to 19-year olds who have had substantial acne at some time during the year and certainly underestimates the cumulative prevalence of acne in adolescence. To the extent that previous acne of this severity, which was not currently active, has adversely affected adolescents, the associations we observed underestimate the total burden of acne.

Nearly one in four adolescents with very much acne reported suicidal ideation. In girls with very much acne, the prevalence of suicidal ideation was more than twice that of those with no/a little acne and in boys it was three times higher. In our multivariate model that controlled for symptoms of depression, family income, and ethnicity, a significant association persisted between substantial acne and suicidal ideation, which was equivalent in both genders. Our findings are supported by a population-based study from New Zealand in 12- to 18-year-old adolescents that showed a significant association of acne with suicide attempts when controlling for psychiatric symptoms (Purvis *et al.*, 2006). Suicidal ideation has previously been explored in small samples among patients with acne and the results are conflicting (Gupta and Gupta, 1998; Picardi *et al.*, 2006; Rehn *et al.*, 2008).

One in four adolescents with very much acne reported mental health problems (SDQ), and a doubled odds in those with substantial acne is found compared with peers with no/a little acne. These findings are consistent with those of some but not all other studies (Kilkenny *et al.*, 1997; Aktan *et al.*, 2000; Smithard *et al.*, 2001; Purvis *et al.*, 2006; Rehn *et al.*, 2008; Arslan *et al.*, 2009; Halvorsen *et al.*, 2009). Contrary to some of the studies mentioned above, our study provides gender-specific results, demonstrates a dose–response relationship ($P<0.01$), and applies a widely used psychometric instrument. Substantial acne has the same level of mental health problems measured by SDQ as shown in neurofibromatosis and epilepsy in children and adolescents (Johnson *et al.*, 2005; Lossius *et al.*, 2006). SDQ, contrary to some other mental health instruments, has questions regarding behavioral consequences of mental health problems (for example, peer problems) in addition to emotional symptoms (Goodman, 1997).

Our findings suggest that the higher rates of reported suicidal ideation and mental health problems among adolescents who are candidates for systemic isotretinoin treatment are likely to reflect, at least in part, underlying increased rates of these issues associated with acne, and are independent of therapy. In this study, we could not directly address the claim that isotretinoin intake increases suicidal ideation and depression. However, information from the Norwegian Prescription Database shows that a maximum of 27 individuals born in 1985 dispensed one or more

## Table 1. Sample characteristics

| | Substantial acne,[1] *N* (%) | No and little acne, *N* (%) | Participants, *N* (%) | Non-participants, *N* (%) |
|---|---|---|---|---|
| *Year of birth* | | | | |
| 1986 | 16 (3.2) | 104 (3.3) | 121 (3.2) | 16 (1.7) |
| 1985 | 404 (81.9) | 2,524 (79.9) | 3,005 (79.7) | 795 (82.0) |
| 1984 | 45 (9.1) | 313 (9.9) | 377 (10.0) | 110 (11.4) |
| 1983 | 14 (2.8) | 89 (2.8) | 112 (3.0) | 12 (1.2) |
| 1982 or earlier | 14 (2.8) | 129 (4) | 146 (3.9) | 36 (3.6) |
| Total | 493 (100) | 3,159 (100) | 3,771 (100) | 969 (100) |
| Missing | | | 4 | 0 |
| *Gender* | | | | |
| Girls | 261 (52.9) | 1,782 (56.4) | 2,103 (55.7) | 347 (35.8) |
| Boys | 232 (47.1) | 1,480 (43.6) | 1,672 (44.3) | 622 (64.2) |
| Total | 493 (100) | 3,162 (100) | 3,775 (100) | 969 (100) |
| Missing | | | 0 | 0 |
| *Household income*[2] | | | | |
| Lower | 115 (28.3) | 595 (22.4) | 728 (23.4) | Not available |
| Middle | 216 (53.1) | 1,418 (53.3) | 1,651 (53.1) | |
| Higher | 76 (18.7) | 647 (24.3) | 729 (23.5) | |
| Total | 407 (100) | 2,660 (100) | 3,108 (100) | |
| Missing | | | 667 | |
| *Ethnicity*[3] | | | | |
| Non-Western | 129 (28.7) | 647 (22.2) | 806 (23.6) | Not available |
| Western | 321 (71.3) | 2,263 (77.8) | 2,611 (76.4) | |
| Total | 450 (100) | 2,910 (100) | 3,417 (100) | |
| Missing | | | 358 | |
| *Symptoms of depression*[4] | | | | |
| No | 307 (64.0) | 2,357 (76.4) | 2,701 (74.6) | Not available |
| Yes | 173 (36.0) | 730 (23.6) | 919 (25.4) | |
| Total | 480 (100) | 3,087 (100) | 3,620 (100) | |
| Missing | | | 155 | |

[1]Self-reported acne (a lot and very much).
[2]The sum of parents' income; middle income is over 85,000 USD and under 170,000 USD.
[3]Non-Western is defined as having both parents from, or being born in, a non-Western country (all except Western Europe, North America, and Australia).
[4]Measured by the Hopkins Symptom Checklist-10 (see text).

prescriptions of isotretinoin from a pharmacy in 2004. This is 0.6% of adolescents born in 1985 in Oslo. If all isotretinoin users reported suicidal ideation and mental health problems, the reported associations would be reduced. However, it is very unlikely that all users participated and used isotretinoin at the time of the study and developed mental problems due to treatment. Several studies have shown less symptoms of depression after successful acne treatment with isotretinoin (Marqueling and Zane, 2005), which supports our findings that active acne is associated with suicidal ideation and mental health problems.

Although psychiatric difficulties are the main risk factor for suicide (Bridge *et al.*, 2006), lack of attachment to friends and family is also associated with increased suicide risk (de Jong, 1992; Ledgerwood, 1999). In our study, the separate introduction of social variables (relation with family and

**Table 2. Number (*n*) and frequency (%) of suicidal ideation and mental health problems (SDQ) in the sample (*N*) and across acne severity**

| | Whole sample, *n*/*N* (%) | Acne severity, *n*/*N* (%) | | | *P*-value for trend |
|---|---|---|---|---|---|
| | | No/little | A lot | Very much | |
| *Suicidal ideation* | | | | | |
| All | 394/3,620 (10.9) | 297/3,131 (9.5) | 71/381 (18.6) | 26/108 (24.1) | <0.01 |
| Boys | 117/1,596 (7.3) | 86/1,365 (6.3) | 19/178 (10.7) | 12/53 (22.6) | <0.01 |
| Girls | 277/2,024 (13.7) | 211/1,766 (11.9) | 52/203 (25.6) | 14/55 (25.5) | <0.01 |
| *Mental health problems (SDQ)* | | | | | |
| All | 421/3,647 (11.5) | 318/3,155 (10.1) | 76/384 (19.8) | 27/108 (25.0) | <0.01 |
| Boys | 108/1,609 (6.7) | 81/1,377 (5.9) | 16/179 (8.9) | 11/53 (20.8) | <0.01 |
| Girls | 313/2,038 (15.4) | 237/1,778 (13.3) | 60/205 (29.3) | 18/55 (29.1) | <0.01 |

Abbreviation: SDQ, Strengths and Difficulties Questionnaire.

**Table 3. Associations in OR between substantial acne (a lot and very much) and suicidal ideation, and substantial acne (a lot and very much) and mental health problems**

| | Crude OR (95% CI) | Adjusted OR[1] (95% CI) | Sample size[2] |
|---|---|---|---|
| *Suicidal ideation* | | | |
| All | 2.38[3] (1.79–3.16) | 1.80[3] (1.30–2.50) | 2,995 |
| Boys | 2.14[3] (1.30–3.53) | 1.84 (1.04–3.26) | 1,316 |
| Girls | 2.67[3] (1.88–3.79) | 1.77[3] (1.18–2.64) | 1,679 |
| *Mental health problems (SDQ)* | | | |
| All | 2.32[3] (1.76–3.05) | 2.25[3] (1.69–3.00) | 3,062 |
| Boys | 2.31[3] (1.81–3.52) | 2.31[3] (1.37–3.88) | 1,343 |
| Girls | 2.52[3] (1.81–3.52) | 2.24[3] (1.59–3.15) | 1,719 |

Abbreviations: CI, confidence interval; HSCL-10, Hopkins Symptom Checklist-10; OR, odds ratio; SDQ, Strengths and Difficulties Questionnaire.
[1]In the adjusted analyses, the following confounders were used: ethnicity, family income, and gender; symptoms of depression (HSCL-10) was not used as a confounder in the analyses with mental health problems.
[2]The same sample was used in both the crude and the adjusted analyses.
[3]Significant with 99% CI.

friends, thriving at school, bullying, and experience with romantic relationships and sexual intercourse) in the multivariate model did not change the association between acne and suicidal ideation. As such relationships are important for many adolescents, these findings further strengthen our suggestion that acne is an independent risk factor for suicidal ideation.

Our study demonstrates a high degree of social impairment among adolescents with substantial acne. We found that increasing reported acne was associated with lower social functioning on all the variables in our study, as seen in significant *P*-value for trend or adjusted ORs. The association between acne and mental health problems measured by SDQ supports our findings regarding social impairment and acne, as there is some degree of overlap between questions in SDQ and the questions that we used to measure social impairments (Goodman, 2001). Our findings are consistent and complement the results from quality of life studies in acne (Lasek and Chren, 1998; Walker and Lewis-Jones, 2006; Jones-Caballero *et al.*, 2007).

Previous studies have suggested that acne affects quality of life more in females than in males (Koo, 1995; Kellett and Gawkrodger, 1999; Mallon *et al.*, 1999; Jones-Caballero *et al.*, 2007). In contrast, we found similar associations of acne with social and psychological impairment in both boys and girls. Boys with acne are more likely to report problems with their family and friends. Girls with substantial acne often reported more problems with thriving at school. Our findings are also interesting in light of the fact that girls are traditionally believed to pay more attention to their appearance. A possible explanation for a comparable impact of acne in both genders may be the fact that acne is often more severe in boys in late adolescence (Burton *et al.*, 1971; Kilkenny *et al.*, 1998; Gollnick *et al.*, 2008) and that females more actively treat their skin problems (Franzke *et al.*, 2009). We found a linear relationship between severity of acne and social impairment, and this is in contrast to most quality of life studies in which acne severity is usually not related to the total score assessed by the instrument.

The changes in OR from crude to adjusted OR in the relation of acne to suicidal ideation and social functioning were mainly caused by the introduction of symptoms of depression, and not by family income or ethnicity in the model. This indicates that in adolescents with acne, mental health issues must be taken into account when social impairment is assessed.

Although causation cannot be definitely proven from associations observed in this cross-sectional study, acne almost certainly causes embarrassment, stigma, shame, guilt,

**Table 4. Number (*n*) and frequency (%) of social impairment in the sample (*N*) and across acne severity**

| | | Acne severity, *n*/*N* (%) | | | |
|---|---|---|---|---|---|
| | Whole sample, *n*/*N* (%) | No/little | A lot | Very much | *P*-value for trend |
| *Low attachment to family* | | | | | |
| All | 866/3,641 (23.8) | 723/3,150 (23.0) | 110/382 (28.8) | 33/109 (30.3) | <0.01 |
| Boys | 384/1,607 (23.9) | 309/1,365 (22.5) | 57/179 (31.8) | 18/53 (34.0) | <0.01 |
| Girls | 482/2,034 (23.7) | 414/1,775 (23.3) | 53/203 (26.1) | 15/56 (26.8) | 0.3 |
| *Low attachment to friends* | | | | | |
| All | 1,020/3,639 (28.0) | 825/3,149 (26.2) | 143/381 (37.5) | 52/109 (47.7) | <0.01 |
| Boys | 501/1,605 (31.2) | 391/1,374 (28.5) | 75/178 (42.1) | 35/53 (66.0) | <0.01 |
| Girls | 519/2,034 (25.5) | 434/1,775 (24.4) | 68/203 (33.5) | 17/39 (30.4) | 0.01 |
| *Not thriving at school* | | | | | |
| All | 1,249/3,390 (36.8) | 1,048/2,950 (35.5) | 150/348 (43.1) | 51/92 (55.4) | <0.01 |
| Boys | 482/1478 (32.6) | 400/1,277 (31.3) | 60/160 (37.5) | 22/41 (53.7) | <0.01 |
| Girls | 767/1,912 (40.1) | 648/1,673 (38.7) | 90/188 (47.9) | 29/51 (56.9) | <0.01 |
| *Experienced bullying* | | | | | |
| All | 218/3,407 (6.0) | 175/3,137 (5.6) | 30/379 (7.9) | 13/109 (11.9) | <0.01 |
| Boys | 93/1,603 (5.8) | 76/1,373 (5.5) | 10/177 (5.6) | 7/53 (13.2) | 0.08 |
| Girls | 125/2,022 (6.2) | 99/1,764 (5.6) | 20/202 (9.9) | 6/56 (10.7) | <0.01 |
| *Never had romantic relationship* | | | | | |
| All | 829/3,603 (23.0) | 686/3,116 (22.0) | 103/379 (27.2) | 40/108 (37.0) | <0.01 |
| Boys | 368/1,593 (23.1) | 303/1,363 (22.2) | 45/177 (25.4) | 20/53 (37.7) | 0.3 |
| Girls | 461/2,010 (22.9) | 383/1,370 (21.8) | 58/202 (28.7) | 20/55 (36.4) | <0.01 |
| *Never had sexual intercourse* | | | | | |
| All | 1,292/3,624 (35.7) | 1,075/3,137 (34.4) | 165/378 (43.7) | 52/109 (47.7) | <0.01 |
| Boys | 576/1,591 (36.2) | 473/1,361 (34.8) | 77/177 (43.5) | 26/53 (49.1) | <0.01 |
| Girls | 716/2,033 (35.2) | 602/1,776 (33.9) | 88/201 (43.8) | 26/56 (46.4) | <0.01 |

and low self-esteem, which are likely to cause psychosocial problems. Acne may cause depression, which then results in impaired social functioning and suicidal ideation. If this is the case, then symptoms of depression are an intermediate variable and should not be included as a confounder in the analyses. If symptoms of depression are an intermediate variable, the link between acne and both suicidal ideation and social impairment is even stronger than in adjusted models and the crude associations will better reflect the true associations.

The causality may also go in the opposite direction. It is possible that psychosocial problems cause stress, and this makes acne worse, possibly through neuroimmunological pathways (Dreno, 2006; Ganceviciene *et al.*, 2009) or social network effects, for example, non-depressed adolescents may be more capable of seeking appropriate health care and information (Berkman *et al.*, 2000).

The strength of this study is the large non-clinical sample size with a high participation rate, reducing the chance of selection bias and enabling generalizations. When generalizing our results, it is important to be aware of the fact that data are collected in a multiethnic northern European city. In addition, inclusion of confounders in the multivariate analyses that are lacking in other similar surveys is a study strength (Kilkenny *et al.*, 1997; Gupta and Gupta, 1998; Picardi *et al.*, 2006; Purvis *et al.*, 2006). Many of the questions and instruments we used have been validated (Goodman, 2001; Strand *et al.*, 2003; Halvorsen *et al.*, 2008) and some of the data originate from an official data source. The participants answered over 200 questions in this survey

**Table 5. Associations in OR between substantial acne (a lot and very much) and social impairments**

| | Crude OR (95% CI) | Adjusted OR[1] (95% CI) | Sample[2] |
|---|---|---|---|
| *Low attachment to family* | | | |
| All | 1.33 (1.07–1.68) | 1.19 (0.93–1.52) | 3,003 |
| Boys | 1.50 (1.07–2.11) | 1.42 (1.00–2.01) | 1,321 |
| Girls | 1.18 (0.85–1.65) | 0.98 (0.69–1.39) | 1,682 |
| *Low attachment to friends* | | | |
| All | 1.75[3] (1.40–2.18) | 1.52[3] (1.21–1.91) | 3,002 |
| Boys | 2.08[3] (1.52–2.85) | 2.03[3] (1.47–2.81) | 1,320 |
| Girls | 1.45 (1.06–1.99) | 1.14 (0.82–1.59) | 1,682 |
| *Not thriving at school* | | | |
| All | 1.57[3] (1.26–1.96) | 1.41[3] (1.12–1.78) | 2,818 |
| Boys | 1.44 (1.03–2.01) | 1.36 (0.97–1.92) | 1,230 |
| Girls | 1.72[3] (1.28–2.33) | 1.48 (1.08–2.01) | 1,588 |
| *Experienced bullying* | | | |
| All | 1.84[3] (1.24–2.73) | 1.39 (0.92–2.10) | 2,992 |
| Boys | 1.46 (0.76–2.79) | 1.24 (0.63–2.44) | 1,319 |
| Girls | 2.18[3] (1.32–3.59) | 1.51 (0.90–2.54) | 1,673 |
| *Never had romantic relationship* | | | |
| All | 1.36 (1.07–1.72) | 1.35 (1.05–1.70) | 2,979 |
| Boys | 1.23 (0.86–1.74) | 1.23 (0.86–1.74) | 1,311 |
| Girls | 1.48 (1.08–2.05) | 1.38 (0.99–1.94) | 1,668 |
| *Never had sexual intercourse* | | | |
| All | 1.51[3] (1.22–1.87) | 1.51[3] (1.21–1.89) | 2,987 |
| Boys | 1.54[3] (1.12–2.10) | 1.58[3] (1.15–2.16) | 1,311 |
| Girls | 1.48[3] (1.10–1.99) | 1.37 (0.98–1.90) | 1,676 |

Abbreviations: CI, confidence interval; HSCL-10, Hopkins Symptom Checklist-10; OR, odds ratio.
[1]In the adjusted analyses, the following confounders were used: gender, ethnicity, family income, and symptoms of depression (HSCL-10).
[2]The same sample was used in both the crude and the adjusted analyses.
[3]Significant with 99% CI.

**Table 6. Associations in adjusted OR between substantial acne (a lot and very much) and suicidal ideation when controlling for six social variables in addition to gender, ethnicity, family income, and symptoms of depression (HSCL-10)**

| Additional adjustment variable | Adjusted OR[1] (95% CI) | Sample |
|---|---|---|
| Low attachment to family | 1.80[1] (1.29–2.51) | 2,993 |
| Low attachment to friends | 1.71[1] (1.22–2.38) | 2,992 |
| Not thriving at school | 1.77[1] (1.25–2.51) | 2,808 |
| Experienced bullying | 1.73[1] (1.24–2.42) | 2,982 |
| Never had romantic relationship | 1.82[1] (1.31–2.53) | 2,969 |
| Never had sexual intercourse | 1.77[1] (1.27–2.46) | 2,977 |

Abbreviations: CI, confidence interval; HSCL-10, Hopkins Symptom Checklist-10; OR, odds ratio.
[1]Significant with 99% CI.

under full confidentiality and had no obvious incentive to aggravate their social, psychiatric, or dermatological problems; this makes the ascertainment of difficult topics such as suicide ideation likely to be more complete. By using answers from single questions as outcomes, the results may be easier to interpret than measuring psychosocial items by health-specific quality of life instruments or utility measures. There are few studies using skin-specific quality of life instruments in acne that include healthy controls or are performed in the general population (Yazici *et al.*, 2004; Walker and Lewis-Jones, 2006). This is mainly because the primary purpose of quality of life instruments is to measure patient problems in clinical trails or in daily practice or with generic questionnaires to compare acne patients with other patient groups.

The main limiting factor in this study in addition to the cross-sectional design is the self-reported data that may cause spurious associations because of dependent misclassification: the tendency of respondents to systematically answer high or low on questions, regardless of their problems. However, with such a consistency of the findings shown in this study, and the little influence of social factors on the relation between acne and suicidal ideation, this is less likely to have had a substantial impact on our findings.

Missing items in the analyses because of merging our data with data from Statistics Norway are a possible problem. However, we were able to match over 80% of the respondents with register data. Another limitation to our findings is the use of multiple testing with many outcomes, which might cause significant findings by chance. In the bivariate analyses, we have indicated which ORs are significant with a CI of 99%, making it less likely that these significant associations reflect chance findings.

Our study demonstrates and quantifies the association of reported acne to increased risk of suicidal ideation, mental health problems, and social impairment in a large population-based sample. Acne may influence life in a large number of adolescents in the community, as seen in the percentage of increase, even though the relative increase reflected in the ORs is quite modest. Especially relevant is the 80% higher level of suicidal ideation in adolescents with substantial acne than among those with no/little acne, independent of symptoms of depression, ethnicity, and family income in this population with low use of isotretinoin. Our results are helpful for clinicians, as subjective complaints are important when choosing treatment. Furthermore, these findings have public health implications because they underscore the need of appropriate health care for adolescent boys and girls in the community.

## MATERIALS AND METHODS

### Setting and study population

This cross-sectional and questionnaire-based study constitutes the Oslo section of the Youth 2004 Study (*Ungdom, 2004*, http://www.fhi.no/dav/A34847D246.pdf). Data were collected at schools or by mail using the same four-page questionnaire. Written and informed consent was obtained from all participants and the Regional Committee for Medical Research Ethics in southeast Norway approved the study. The Declaration of Helsinki Principle protocols were followed. At school, a field worker informed the students about the study, administered the questionnaire, and was available for answering questions in the classroom when the students filled in the survey. At high schools, there are public-health nurses for students with health-related problems. These services were available for students taking part in the survey. For students absent that day, the teacher provided questionnaires and instructions when the students returned. To adolescents not participating at school, an invitation letter, information brochure, consent form, and a prestamped return envelope were mailed.

In the spring of 2004, all students in their final year of high school in Oslo, Norway, were approached. Of the 3,659 students invited, 3,308 participated (90%). Students who had participated in a previous study in Oslo in 2000/2001 (*UNGHUBRO*, http://www.fhi.no/dav/AD07555E4B.doc), but not attending the final year of school ($n=1,085$), were invited to participate by mail. Of these adolescents, 467 (43%) returned the questionnaire. For non-participants we have data on age and gender.

### Questionnaire and measurements

The complete questionnaire included self-reported answers on somatic health, mental health, lifestyle, and health-care behavior. The questions used in this publication are described elsewhere (Supplementary Table S1 online).

***Acne.*** The four possible responses to the question regarding the occurrence of pimples the previous week were no, yes a little, yes a lot, and yes very much, which we operationalized as no acne, acne not justifying medical attention, acne justifying medical attention, and acne justifying early medical attention (Rea *et al.*, 1976; Dalgard *et al.*, 2003; Halvorsen *et al.*, 2008). We define substantial acne as acne in need of medical attention, that is, a lot and very much. The response to the question pertaining to acne has been validated in a study of 260 high-school students in Oslo (Halvorsen *et al.*, 2008), and the overall agreement was 80% (not previously published) when comparing objective findings with subjective answers; the dermatologist's findings were dichomized into no and a little versus substantial acne and the students' response was dichotomized into no and a little versus a lot and very much (Halvorsen *et al.*, 2008).

***Suicidal ideation.*** Four possible answers on the question regarding thoughts about ending life the previous week were dichotomized between not troubled versus slightly troubled/much troubled/very much troubled. The question was taken from the 90-question version of the Hopkins Symptom Checklist (HSCL-90), an established psychometric instrument for use in epidemiological studies (Lipman *et al.*, 1979).

***Mental health problems.*** Mental health problems during the last 6 months were self-assessed by 20 questions in the SDQ. Adolescents scoring in the upper decile are considered to have emotional and behavioral problems (Goodman, 1997, 2001). The SDQ measures four problem domains: hyperactivity (distractible, persistent, restless, fidgety, reflective), emotional symptoms (fears, worries, clingy, unhappy, somatic), conduct problems (lies, fights, tempers, steals, obedient), and peer problems (good friend, popular, best with adults, solitary, bullied) (Goodman, 2001).

***Social impairment.*** Social impairment was measured by six questions on social functioning. Relevant questions were chosen as indicators of social functioning, as no established instrument exists for use in the general population in adolescence.

***Household income and ethnicity data.*** Data on household income and ethnicity were obtained from Statistic Norway, an official institution that holds information on all citizens. Symptoms of depression were quantified by the Hopkins Symptom Checklist (HSCL-10) with 10 items, a validated instrument measuring mental distress (Strand *et al.*, 2003).

### Missing

Of 3,775 participants, the question regarding acne was answered by 3,655 (97%). The response rate was above 95% on all outcome variables, except for thriving at school (90%) and bullying (90%).

### Statistical analysis

SPSS software for Windows (Version 16, SPSS, Chicago, IL) was used for statistical analyses. Test for trend with significance set at $P<0.05$ was calculated to investigate a possible dose–response relationship between degree of acne and prevalence of psychosocial problems. Associations were assessed by logistic regression and ORs with 95% and 99% CI were calculated.

## CONFLICT OF INTEREST

The authors state no conflict of interest.

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## SUPPLEMENTARY MATERIAL

Supplementary material is linked to the online version of the paper at http://www.nature.com/jid

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